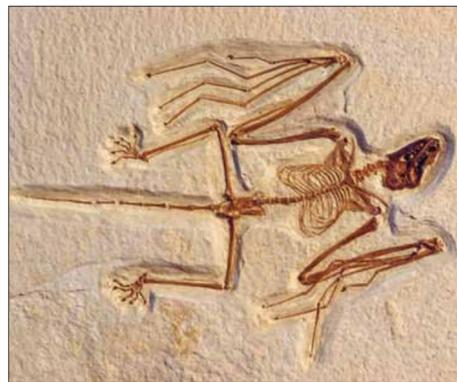
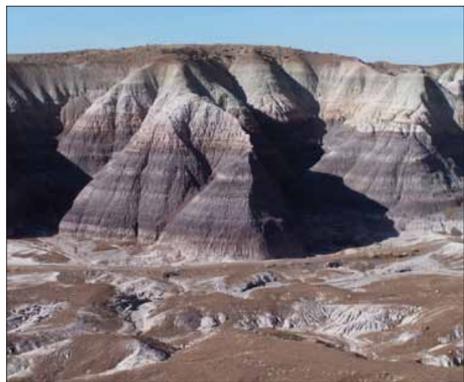


GEOTIME IN THE NATIONAL PARKS



SELECTED NATIONAL PARK SYSTEM AREAS THROUGH GEOLOGIC TIME

- AGATE FOSSIL BEDS NATIONAL MONUMENT, NEBRASKA
- BADLANDS NATIONAL PARK, SOUTH DAKOTA
- BERING LAND BRIDGE NATIONAL PRESERVE, ALASKA
- BRYCE CANYON NATIONAL PARK, UTAH
- FOSSIL BUTTE NATIONAL MONUMENT, WYOMING
- HAGERMAN FOSSIL BEDS NATIONAL MONUMENT, IDAHO
- HAWAII VOLCANOES NATIONAL PARK, HAWAII
- JOHN DAY FOSSIL BEDS NATIONAL MONUMENT, OREGON
- THEODORE ROOSEVELT NATIONAL PARK, NORTH DAKOTA
- YELLOWSTONE NATIONAL PARK, WYOMING, MONTANA, & IDAHO
- BIG BEND NATIONAL PARK, TEXAS
- CHACO CULTURE NATIONAL HISTORICAL PARK, NEW MEXICO
- DINOSAUR NATIONAL MONUMENT, COLORADO & UTAH
- GLEN CANYON NATIONAL RECREATION AREA, ARIZONA & UTAH
- MESA VERDE NATIONAL PARK, COLORADO
- PETRIFIED FOREST NATIONAL PARK, ARIZONA
- BLUE RIDGE PARKWAY, NORTH CAROLINA & VIRGINIA
- CHESAPEAKE & OHIO CANAL NATIONAL HISTORICAL PARK, WASHINGTON DC, MARYLAND, & WEST VIRGINIA
- CUMBERLAND GAP NATIONAL HISTORICAL PARK, KENTUCKY, VIRGINIA, & TENNESSEE
- DEATH VALLEY NATIONAL PARK, CALIFORNIA & NEVADA
- GLACIER BAY NATIONAL PARK & PRESERVE, ALASKA
- GRAND CANYON NATIONAL PARK, ARIZONA
- GREAT SMOKY MOUNTAINS NATIONAL PARK, TENNESSEE & NORTH CAROLINA
- GUADALUPE MOUNTAINS NATIONAL PARK, TEXAS
- MAMMOTH CAVE NATIONAL PARK, KENTUCKY
- WIND CAVE NATIONAL PARK, SOUTH DAKOTA
- GLACIER NATIONAL PARK, MONTANA
- GRAND TETON NATIONAL PARK, WYOMING
- SHENANDOAH NATIONAL PARK, VIRGINIA
- VOYAGEURS NATIONAL PARK, MINNESOTA



To learn more, visit <http://go.nps.gov/GeoTime/>



GEOLOGIC TIME IN THE NATIONAL PARKS



THE NATIONAL PARK SYSTEM contains a magnificent record of geologic time because rocks from each period of the geologic time scale are preserved in park landscapes. No single park has rocks from every geologic period, though some come close.

With the help of clocks, calendars, and appointment books, we organize our lives around time. We divide time into years, months, weeks, and days. Likewise, geologists created a time scale to organize Earth's history into eons, eras, periods, and epochs. While a human life spans decades, Earth's history spans 4,600 million years!

The geologic time scale began to take shape in the 1700s. Geologists used fundamental concepts (see box) to understand the chronological order of rocks around the world. It wasn't until the advent of radiometric dating techniques in the middle 1900s that reliable dates could be assigned to the previously named geologic time divisions.

GEOLOGIC TIME PARKS

Every park contains some slice of geologic time. Here we highlight a few parks associated with each geologic time period. This is not to say that a particular park has only rocks from the specified period. Rather, rocks in a selected park exemplify a certain event or preserve fossils or rocks from a certain geologic age.

GEOLOGIC TIME "CALENDAR"

The immensity of geologic time—4,600 million years—is hard to comprehend. The timeline below shows the major divisions of geologic time, (the Precambrian, Paleozoic, Mesozoic, and Cenozoic) as if they were compressed into one calendar year.



CREDBITS: Project: Jim Wood (NPS), Jason Kenworthy (NPS), Tim Connors (NPS), Rebecca Port (NPS), Vincent Santucci (NPS), Filla Balwag (AGI), Geoff Camphire (AGI); Design: Angela Terry Design; IMAGE CREDITS: Front images (left to right, down) Photos courtesy of NPS: Petrified Forest NP (Marge Post); Big Bend NP (Steve Wick); Bat fossil from Fossil Butte NM (Arvid Aase); Glacier NP (Jeremy Wei); Guadalupe Mountains NP (Rebecca Port); Bryce Canyon NP; Ice Age Mammoth (Mauricio Anton, Creative Commons CC BY 2.5); Hawaii Volcanoes NP (P. Stoffer); Dinosaur NM; Glacier Bay NP&P (Vincent Santucci); Glen Canyon NRA (Rebecca Port); Grand Canyon NP; Grand Teton NP; Theodore Roosevelt NP (Mary Brazzell); Mammoth Cave NP (Vickie Carson); Badlands NP (Larry McAfee); Back images (top to bottom, left to right): Precambrian: NOAA Photo; Permian: Rebecca Port; Pennsylvania: Public Domain; Mississippian: NPS Photo; Devonian: Joseph Smith/Public Domain; Silurian: NPS Photo/Vincent Santucci; Ordovician: Petter Beckman, Creative Commons (CC BY SA 3.0); Cambrian: Rebecca Port; Cretaceous: NPS Photo/Thomas Lytle; Jurassic: Mariana Ruiz/Public Domain; Triassic: Rebecca Port; Quaternary: NPS Photo/Janene Driscoll; Neogene: NPS Photo; Paleogene: NPS Photo/Tim Connors

TO LEARN MORE VISIT

<http://go.nps.gov/GeoTime/>

PRECAMBRIAN

During the Precambrian, continents formed and our modern atmosphere developed, while early life evolved and flourished.

542 MYA



EARTH FORMS

PRECAMBRIAN PARKS

4,600 TO 542 MYA (MILLION YEARS AGO)
The oldest rocks in the NPS, at least 2,700 million years old, are found in **GRAND TETON** and **VOYAGEURS** national parks. The 1,400-million-year-old stromatolites of **GLACIER NATIONAL PARK** are among the oldest fossils in the NPS. The 1,100-million-year-old rocks of **SHENANDOAH NATIONAL PARK** represent molten materials emplaced during ancient mountain-building events.

PALEOZOIC

In North America, the Paleozoic is characterized by the advance and retreat of shallow seas and repeated continental collisions that formed the Appalachian Mountains.

251 MYA



PERMIAN PARKS

299 TO 251 MYA
The massive cliffs of El Capitan in **GUADALUPE MOUNTAINS NATIONAL PARK** represent a Permian-age reef along the supercontinent Pangaea. The uppermost rocks of **GRAND CANYON NATIONAL PARK** are also Permian.



PENNSYLVANIAN PARKS

318 TO 299 MYA
Rocks in **CUMBERLAND GAP NATIONAL HISTORICAL PARK** represent vast Pennsylvanian-age swamps. Plant life in those swamps later became coal found in the eastern United States.



MISSISSIPPIAN PARKS

359 TO 318 MYA
The extensive caves of **MAMMOTH CAVE** and **WIND CAVE** national parks developed in limestone deposited during the Mississippian. Warm, shallow seas covered much of North America, which was close to the equator.



DEVONIAN PARKS

416 TO 359 MYA
The Devonian is part of the "Age of Fishes." Fish fossils from **DEATH VALLEY NATIONAL PARK** shed light on the early evolution of fish in North America. Tilted Devonian rocks in **CHESAPEAKE & OHIO CANAL NATIONAL HISTORICAL PARK** attest to continued Appalachian Mountain formation.



SILURIAN PARKS

444 TO 416 MYA
Excellent exposures and well-preserved fossils in Silurian rocks of **GLACIER BAY NATIONAL PARK & PRESERVE** provide clues to the timing of the assembly of Alaska's assembly from a variety of continental fragments.



ORDOVICIAN PARKS

488 TO 444 MYA
SHENANDOAH and **GREAT SMOKY MOUNTAINS** national parks, along with the **BLUE RIDGE PARKWAY** that connects them, pass through rocks from the core of the Appalachian Mountains. The mountains began forming during the Ordovician and eventually attained elevations similar to those of the Himalayas.



CAMBRIAN PARKS

542 TO 488 MYA
The flat layers of rock exposed in **GRAND CANYON NATIONAL PARK** encompass much of the Paleozoic, beginning in the Cambrian where they record an ancient shoreline.

FUNDAMENTAL GEOLOGIC CONCEPTS

Geologists use these concepts to place sequences of rock in chronological order. The geologic time scale was then developed to organize the immense amount of time represented by the rocks.

UNIFORMITARIANISM. Geologic processes operating on the Earth's crust have acted in the same manner and relative intensity throughout geologic time. "The present is the key to the past."

SUPERPOSITION. In an undisturbed sequence of sediments or rocks, the older layers occur at the bottom with successively younger layers on top.

ORIGINAL HORIZONTALITY. Layers of sediment are originally deposited horizontal to the Earth's surface.

FAUNAL SUCCESSION. Fossils often exhibit identifiable patterns or characteristics which progressively change over time.

MESOZOIC

During the Mesozoic, Pangaea began separating into the modern continents, the Rocky Mountains rose, and dinosaurs ruled the landscape.

65.5 MYA



CRETACEOUS PARKS

145 TO 65.5 MYA
Many now-arid western parks, including **CHACO CULTURE NATIONAL HISTORICAL PARK** and **MESA VERDE NATIONAL PARK**, were inundated by the Cretaceous Interior Seaway that bisected North America. Massive dinosaur and other reptile fossils are found in Cretaceous rocks of **BIG BEND NATIONAL PARK**.



JURASSIC PARKS

200 TO 145 MYA
DINOSAUR NATIONAL MONUMENT is home to thousands of dinosaur fossils making it a true "Jurassic Park." A vast desert covered southwest North America in the Jurassic and ancient sand dunes now form tall cliffs in many parks including **GLEN CANYON NATIONAL RECREATION AREA**.



TRIASSIC PARKS

251 TO 200 MYA
The brightly colored Triassic rocks of **PETRIFIED FOREST NATIONAL PARK** yield not only the petrified trees but many other plant and animal fossils.

251 MYA

Learning Activity: It's About Time

Grade Level: 4-9

Source: National Park Service

Scientists do not measure geologic time on a clock or calendar. They use a timeline that is based on the age of rocks and the fossils found in those rocks. The geologic timeline also includes the changes in life that occurred over millions of years. To understand how a timeline works, you can make a geologic timeline scaled to your arm span.

To learn more, visit:
<http://go.nps.gov/LearnGeoTime/>

CENOZOIC

North America's characteristic landscapes began to develop during the Cenozoic, a time of rapid mammal evolution and climate change.

TODAY



QUATERNARY PARKS

2.6 MYA TO TODAY
Massive ice sheets advanced and retreated during much of the Quaternary, carving landscapes in many parks. **BERING LAND BRIDGE NATIONAL PRESERVE** contains geologic evidence of lower ice age sea level, facilitating the prehistoric peopling of the Americas. The youngest rocks in the NPS include the lava of **HAWAII VOLCANOES NATIONAL PARK** and the travertine at **YELLOWSTONE NATIONAL PARK**, which can be just a few hours old.



NEOGENE PARKS

23 TO 2.6 MYA
Some of the finest Neogene fossils on the planet are found in the rocks of **AGATE FOSSIL BEDS** and **HAGERMAN FOSSIL BEDS** national monuments.



PALEOGENE PARKS

65.5 TO 23 MYA
Colorful Paleogene rocks are exposed in the hoodoos of **BRYCE CANYON NATIONAL PARK** and the badlands of **BADLANDS** and **THEODORE ROOSEVELT** national parks. Extraordinary Paleogene fossils are found in **FOSSIL BUTTE** and **JOHN DAY FOSSIL BEDS** national monuments, among other parks.

65.5 MYA

DECEMBER 31, 11:37 PM
Homo sapiens evolves (200,000 years ago)

DECEMBER 12
Paleozoic ends, Mesozoic begins (251 MYA)

NOVEMBER 18
Precambrian ends, Paleozoic begins (542 MYA)

NOVEMBER 25
Flowering plants evolve and diversify (100 MYA)

DECEMBER 26
Mesozoic ends, Cenozoic begins; Dinosaurs become extinct (65.5 MYA)

DECEMBER 31, 8:12 PM
Pleistocene ice ages begin (~2 MYA)

